

# Designing a lesson plan based on the 5E model: Flipped classroom practices for hybrid art education using Blender 3D

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## Highlights

- Blender 3D training integrated with the 5E model and flipped classroom strategies
- An eight-week instructional program developed based on the ADDIE model to enhance students' spatial visualization skills
- A hybrid learning environment created by balancing face-to-face instruction with asynchronous video modules

**Article Info:** Research Article

**Keywords:** ADDIE model, 5E learning model, lesson plan development, Blender 3D, hybrid learning environment, flipped learning

## Abstract

This study aims to develop student-centered lesson plans that integrate the 5E learning model and flipped classroom strategies in the context of 3D modeling instruction using Blender 3D. The lesson plans were structured in accordance with the ADDIE instructional design model and implemented through an eight-week pilot study at the Faculty of Fine Arts in a public university in Turkey. During the implementation process, field notes taken by the instructor were analyzed as qualitative data to evaluate student engagement, technical challenges, and the effectiveness of instructional strategies. The findings indicate that video-supported pre-learning enhanced the success of practical applications, the flipped classroom strategy was particularly effective in assessment tasks, and the “Explore,” “Elaborate,” and “Evaluate” phases of the 5E model emerged as the most prominent. The results suggest that the proposed hybrid model facilitates the use of 3D tools in visual arts education and supports student motivation.

## 1. Introduction

The rapid advancements in educational technologies have made it inevitable for teachers to integrate digital tools into their classroom activities (Mishra & Koehler, 2006; Polly et al., 2010). Bibliometric analyses conducted in Turkey reveal that digital tools are being used more frequently and consciously in educational settings (Çivril & Aruğaslan, 2024). Furthermore, international studies confirm that this trend is global in nature. For instance, OECD reports emphasize that the integration of digital technologies into classrooms has significantly increased worldwide, supporting student-centered and technology-enhanced practices across various disciplines (Forsström et al., 2025). Similarly, UNESCO's global monitoring reports reveal that digital tools are recognized as essential components of innovative learning environments in both developed and developing countries (UNESCO, 2023). This trend supports the proliferation of student-centered and technology-enhanced practices in visual arts courses. In visually oriented disciplines such as art and design, there is a growing need for innovative instructional methods that foster students' creative thinking and spatial visualization skills (Koçak Usluel et al., 2015). In visual arts education, student-centered learning is facilitated through technology-enhanced instruction by enabling learners to actively

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engage with digital tools, construct knowledge through exploration, and express creativity in personalized ways. For example, using Blender 3D in flipped classroom settings allows students to access asynchronous video modules before class, promoting self-paced learning and preparation. During face-to-face sessions, students apply what they've learned by creating original 3D models, which fosters autonomy and creative problem-solving. Studies have shown that integrating digital technologies such as VR, AR, and AI into visual arts instruction enhances students' spatial thinking and supports constructivist learning environments (Pan, 2024; Erişti & Freedman, 2024). These approaches shift the instructional focus from teacher-led demonstrations to learner-driven exploration, aligning with the principles of student-centered pedagogy. Although powerful softwares like Blender 3D—which feature complex interfaces for novice users—remain underutilized due to the lack of guiding materials, yet they offer significant potential for developing these skills. Blender 3D is an open-source and free software developed by the Blender Foundation for 3D modeling, animation, visual effects, and game design. Widely used across various fields such as architecture, engineering, art, and education, Blender 3D is preferred for both professional and educational content creation thanks to its versatile tools (Blender Foundation, 2025; Branch, 2009).

A lesson plan is a fundamental tool that involves specifying learning objectives, selecting appropriate methods and materials, and planning assessment strategies (Kirschner et al., 2009). The 5E model (Engage, Explore, Explain, Elaborate, Evaluate) is grounded in constructivist learning theory. The ADDIE model (Analysis, Design, Development, Implementation, Evaluation) offers a systematic instructional design process, and both are among the most widely adopted approaches in contemporary instructional planning (Lim et al., 2010; Brown & Warschauer, 2006). Flipped classroom strategies have been shown to enhance the learning process by shifting the focus from passive reception to active engagement. Bergmann and Sams (2012) emphasize that this model ensures students arrive to class prepared, thereby allowing instructional time to be devoted to deeper exploration, problem-solving, and interactive activities. Similarly, Enfield (2013) found that the flipped classroom increases student motivation and accountability, while also providing greater opportunities for active participation and applied learning during class sessions. Together, these studies highlight how flipped instruction fosters both preparation and in-class engagement, ultimately supporting more meaningful learning outcomes. Combining the flipped classroom strategy with the 5E model, which is based on constructivist principles, has been shown to support student-centered instructional processes (Akçayır & Akçayır, 2018). Professional-grade modeling tools such as Blender 3D require instructional support, especially for novice learners, due to their complex interfaces and steep learning curves (van Gumster, 2020).

Although the 5E model and flipped classroom practices are widely discussed in general education, their integrated application in 3D modeling and digital art education remains limited. Recent studies indicate that teaching complex 3D software like Blender 3D presents significant pedagogical challenges, as students often struggle with cognitive overload when technical instruction is delivered solely through traditional lectures (Karaca & Ocak, 2017; Sari et al., 2024). This study addresses these shortcomings by utilizing the 5E model's inquiry-based phases to bridge the gap between theoretical knowledge and practical digital application. Unlike prior research, this study extends the 3D training literature by integrating the ADDIE design process as a systematic framework for hybrid art education, specifically leveraging flipped learning to shift technical software mastery to out-of-class hours (Liu & Fan, 2024; Abuhassna et al., 2024). Thus, the integration of these concepts is justified by the need for a more scaffolded, student-centered approach that prioritizes creative studio time over repetitive technical demonstration (Schallert et al., 2022; Parlak & Kinay, 2024). The aim of this study is to develop student-centered hybrid lesson plans by integrating the 5E learning model with the flipped classroom approach in 3D modeling courses conducted using Blender 3D software. In this context, hybrid refers to a blended instructional design that combines face-to-face studio activities with online, technology-enhanced learning components. The lesson plans were structured in accordance with the five phases of the ADDIE instructional design process: analysis, design, development, implementation, and evaluation. The eight-week pilot implementation was carried out within the Graphic Arts course at the Faculty of Fine Arts of a public university located in western Turkey.

## 2. Literature

In contemporary educational research, constructivist approaches have been emphasized for their ability to foster active participation and deeper conceptual understanding across disciplines (Jonassen, 1999; Tamim et al., 2011). Within this framework, the 5E learning model offers a structured pathway that supports inquiry-based engagement and progressive knowledge construction (Bybee et al., 2006). In this context, the 5E model provides a constructivist framework that supports active student engagement and conceptual development. The visual representation of the 5E learning cycle is presented in Figure 1.

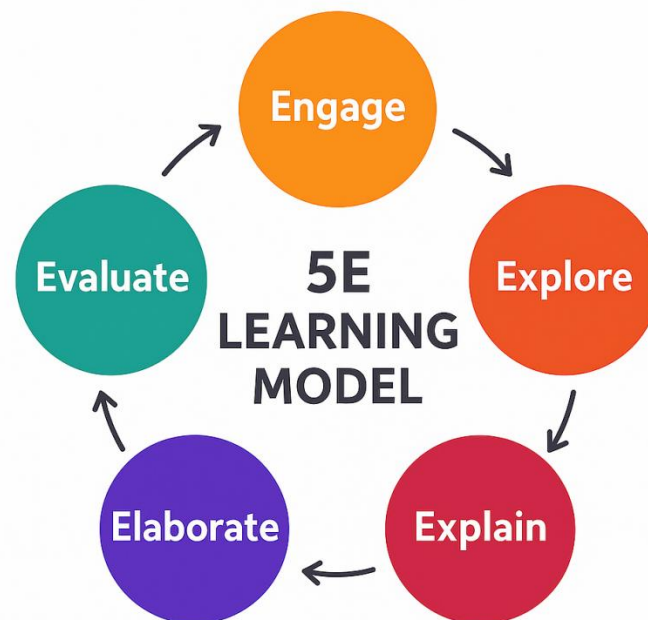


Figure 1 The 5E Learning Model

The 5E learning model is an instructional approach grounded in constructivist learning theory, aiming to promote active student participation in classroom practices (Bybee et al., 2006). The model is rooted in the learning cycle approach developed by Karplus and Thier in the 1960s. Within the framework of the Science Curriculum Improvement Study (SCIS) project, Karplus and Thier designed a three-phase learning model inspired by Piaget's theory of cognitive development, which encouraged students to construct scientific concepts through exploration, observation, and explanation (Karplus & Thier, 1967). In this model, students are first guided to observe a scientific phenomenon, then engage in experimental activities to construct concepts, and finally consolidate their learning through explanation.

This constructivist approach was later expanded by the Biological Sciences Curriculum Study (BSCS) into the 5E learning model, incorporating the phases of Engage, Explore, Explain, Elaborate, and Evaluate (Bybee et al., 2006; Tanner, 2010). These phases enable students to activate prior knowledge, engage in exploratory activities, explain concepts, apply their understanding to new situations, and ultimately evaluate their learning (Tanner, 2010). Studies conducted in Turkey have shown that the 5E model enhances students' academic achievement (Ergin et al., 2007) and helps address conceptual misunderstandings (Ulaş et al., 2012). Moreover, integrating the 5E model into lesson planning has been observed to make the learning process more interactive and meaningful, particularly improving student performance and motivation in art and design education (Sakin, 2018). By offering a learning cycle that allows students to construct their own learning processes, the 5E model facilitates the pedagogical grounding of content supported by digital tools. The integration of the 5E learning cycle within the ADDIE framework provides both pedagogical depth and systematic structure: while the 5E model ensures constructivist, inquiry-based learning activities, ADDIE organizes these phases into a coherent instructional design process. Thus, the

two models complement each other by aligning student-centered exploration with a flexible and iterative planning cycle.

Similarly, the ADDIE instructional design model—frequently referenced in the literature on educational technology and instructional design—serves as a key guide in lesson planning due to its systematic and flexible structure (Szabo, 2022). The visual representation of the ADDIE model cycle is presented in Figure 2.

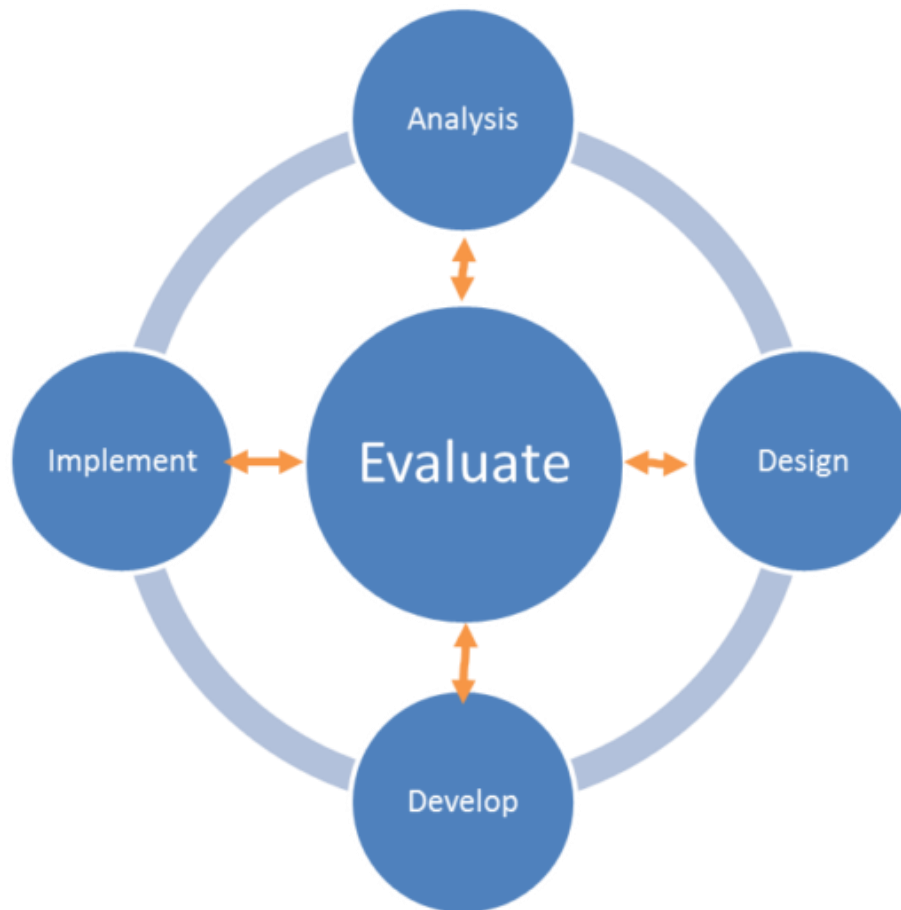


Figure 2 ADDIE Instructional Design Model

The ADDIE model offers a holistic process that begins with needs analysis and extends through implementation and evaluation phases (Hodell, 2015). Although traditionally composed of five stages, contemporary applications of the model incorporate an evaluation cycle at the end of each phase. Viewing evaluation not as a single step at the end of development, but as a continuous practice integrated into every stage of the process, indicates that the model has shifted from a linear structure to a cyclical one (Morrison, 2015). The flexibility and feedback-oriented structure of the model have become particularly prominent in distance and hybrid learning environments (Szabo, 2022). Park and Jo (2023) propose a flexible and effective design process for hybrid learning by integrating the ADDIE instructional design model with rapid prototyping. Their study emphasizes the need to enrich the traditional ADDIE process with dynamic feedback loops, thereby enabling learning experiences to become more student-centered and adaptable. Similarly, in a study conducted by Gök and Karamete (2025), structured activities were developed by combining the ADDIE instructional design model with the 5E learning model, demonstrating that this approach supports students' conceptual thinking and problem-solving skills. This finding suggests that when constructivist instructional models are integrated with systematic design processes across disciplines, meaningful improvements in learning outcomes can be achieved. In the same vein, Davis (2013) highlights that the ADDIE model provides a phased and systematic structure for information literacy education. In this context, the model is widely used in lesson design across various disciplines and allows for content

refinement through formative evaluation at each stage (Szabo, 2022; Park & Jo, 2023). An experimental study conducted in Turkey found that delivering online activities through a structured instructional model had a significant impact on conceptual learning (Palta Benek & Çirkinoğlu Şekercioğlu, 2023). This finding underscores the potential of systematic instructional design models like ADDIE to enhance student achievement when supported by digital content.

The flipped classroom strategy enables more efficient use of in-class time by ensuring that students come to class prepared (Akçayır & Akçayır, 2018). This approach facilitates the learning process in the use of technically demanding digital tools such as Blender 3D by incorporating asynchronous video modules and interactive content (van Gumster, 2020). Indeed, a study conducted by Balıkçı (2015) found that lesson plans structured with the flipped classroom model significantly improved students' academic achievement and their positive attitudes toward the course. Recent research on the educational use of Blender 3D reveals that students actively engage their spatial thinking and 3D perception skills when designing mixed reality scenes with this tool (Horváthová et al., 2023). However, due to its complex interface, the need for instructional support and structured content becomes more pronounced, highlighting the importance of a clear framework in instructional design (Peterson, 2003). In response to these needs, hybrid lesson plans have been developed to integrate pedagogical goals with technological infrastructure, thereby facilitating the monitoring of student progress and systematically supporting 3D content production in visual arts education (Bufasi et al., 2024).

### *2.1. Theoretical Framework*

Integrating digital tools with constructivist instructional models in visual arts education provides a robust foundation both pedagogically and technologically. Approaches such as the 5E learning model, the ADDIE instructional design process, and the flipped classroom strategy have been identified as effective tools for designing student-centered and interactive learning environments (Gezer & Oruç, 2020; Noraslı, 2024; Urfa, 2018). Bybee et al. (2006) emphasize that the 5E model offers a learning cycle that enables students to structure their scientific and creative thinking processes. The ADDIE model, with its systematic structure and feedback-oriented flexibility, is widely applied in hybrid learning environments; when combined with rapid prototyping, it supports iterative and student-centered design processes (Park & Jo, 2023).

Furthermore, the pedagogically aligned use of professional digital content creation tools such as Blender 3D within these instructional models has been shown to enhance students' spatial thinking, visualization, and creative production skills (Porat & Ceobanu, 2024; Schallert et al., 2022). The hybrid lesson plans developed in this context not only facilitate the achievement of instructional goals but also make the learning process more flexible, interactive, and sustainable. In summary, this integration demonstrates how constructivist models, systematic design processes, and flipped strategies can be combined to address the challenges of teaching complex 3D tools. By explicitly linking these approaches, the study contributes a novel framework that extends prior research on 3D training and provides practical guidance for student-centered digital art education.

## **3. Methodology**

This section provides a detailed explanation of the instructional design process structured in accordance with the theoretical foundations of the study. The research model, data collection instruments, sample group, data analysis techniques, validity and reliability measures, and implementation steps are presented systematically. The development of lesson plans was guided by the integration of the 5E learning model and the ADDIE instructional design process, with hybrid lesson plans conducted through Blender 3D software designed based on constructivist learning principles. The qualitative data collected throughout the process were primarily based on the instructor's field notes, while the implementation steps were carried out through online and face-to-face activities enriched with flipped classroom strategies.

### *3.1. Research Model/Design*

This study employed design-based research (DBR), a methodological approach that emphasizes the systematic design, development, and iterative refinement of educational practices in authentic contexts

(Richey & Klein, 2007; Wang & Hannafin, 2005). DBR is characterized by cycles of planning, implementation, analysis, and revision, ensuring both practical improvements and theoretical contributions. Within this framework, the ADDIE instructional design model was adopted as the foundational structure for organizing instructional content. Comprising the phases of analysis, design, development, implementation, and evaluation, ADDIE provided iterative cycles through which lesson plans were planned, tested, and refined. Each stage was informed by observational data and student feedback, thereby ensuring methodological rigor and responsiveness to classroom realities (Molenda, 2003; Peterson, 2003).

The choice of this model was directly related to the study's aim of designing a Blender 3D course and developing lesson plans aligned with the 5E learning model. These plans were further enriched through the integration of flipped classroom strategies. The combined use of 5E and ADDIE allowed the lesson plans to be developed holistically: while the 5E model offered a constructivist learning sequence that fostered conceptual change and scientific process skills, ADDIE provided a systematic and flexible framework for planning, implementing, and evaluating this sequence. Consequently, the integration of DBR, ADDIE, and 5E ensured both pedagogical depth and iterative refinement throughout the research process (Schallert, et al., 2022).

### *3.2. Study Group*

The study group consisted of 14 students enrolled in the Graphic Arts course at the Faculty of Fine Arts, including 2 male and 12 female participants. Since the participants were receiving instruction in 3D modeling as part of this course, a convenience sampling method was employed in the selection of the sample. Convenience sampling refers to a subgroup of individuals who are accessible and from whom data can be collected when it is not feasible for the researcher to reach the entire population. This sampling method is particularly preferred in studies with limitations related to time, cost, or accessibility (Büyüköztürk, 2012). In this study, it was chosen because the students had direct opportunities to interact with digital tools during computer-aided modeling and visual effects design processes

### *3.3. Data Collecting Tools*

Handwritten field notes maintained by the researcher in a dedicated field notebook served as the sole data collection instrument. Given the researcher's dual role as the instructor, these notes integrated both observational and instructional perspectives. In qualitative inquiry, field notes are recognized as a robust data source, allowing for the systematic documentation of interactions, behaviors, and environmental processes (Çelik et al., 2020; Yıldırım & Şimşek, 2018). These notes were consistently maintained throughout the implementation phase to capture the instructional flow, student engagement, activity feasibility, and critical pedagogical moments. Recognizing the potential bias introduced by the researcher's dual role, this limitation was explicitly acknowledged and addressed through several strategies. Field notes were systematically recorded immediately after sessions to reduce recall bias, and regular comparison with student feedback was conducted to ensure consistency. Triangulation across multiple data sources and reflexive consideration of the researcher's positionality further enhanced credibility and methodological rigor. Consequently, these qualitative records provided a substantial basis for evaluating the practical efficacy and pedagogical alignment of the designed lesson plans.

### *3.4. Data Analysis*

In this study, the field notes systematically recorded by the researcher during the implementation process were analyzed using the content analysis method. These notes were handwritten in a dedicated notebook immediately after each lesson and during lesson breaks, documenting student observations and instructional reflections. Content analysis is a qualitative research technique that enables the systematic examination of data obtained from texts, visuals, audio, or other forms of communication. This method aims to classify data according to specific themes, categories, or concepts in order to derive meaningful results. According to Krippendorff (2004), content analysis is a research technique used to make replicable and valid inferences from texts (or other meaningful materials) regarding their usage contexts. Through this method, both the descriptive and interpretive dimensions of the field notes were revealed.

The data obtained from the expert review form consisted of structured feedback on the implementation and content of the 5E lesson plans. These inputs were analyzed within the framework of the ADDIE instructional design model. Specifically, experts' comments were categorized according to themes such as pedagogical coherence, feasibility of activities, and content appropriateness. The feedback was then incorporated into the "Design" and "Development" phases of the ADDIE cycle, leading to targeted revisions of the lesson plans. Through this process, the expert reviews functioned not only as evaluative input but also as a systematic mechanism for strengthening the validity and reliability of the instructional design.

### *3.5. Validity and Reliability*

In this study, validity and reliability were ensured through expert reviews and systematic qualitative analysis. In qualitative research, expert opinion is recognized as both a valid and reliable method of data collection during the development of instructional materials, and it also serves as a functional evaluation tool (Çepni, 2012; Tutar, 2022; Aslan & Erbenzer, 2023). The lesson plans developed by the researcher were reviewed by two faculty members—one specializing in art education and the other in instructional design. Based on the feedback received from these experts, necessary revisions were made to strengthen the content validity and pedagogical appropriateness of the materials.

The field notes, handwritten by the instructor-researcher in a dedicated notebook immediately following each session, were transcribed into an Excel file to facilitate systematic management. These qualitative data were subjected to a content analysis process, with thematic coding conducted independently by two researchers. To ensure inter-rater reliability, both coders worked separately before comparing their initial coding schemes. Any discrepancies were resolved through iterative discussion until full consensus was reached, thereby reinforcing the reliability and replicability of the analysis.

Inter-coder agreement was calculated using the formula proposed by Miles and Huberman (1994):  $[\text{agreement}/(\text{agreement} + \text{disagreement}) \times 100]$ . In this study, the agreement rate was computed as  $[45/48 \times 100]$ , yielding 93.75%. According to Miles and Huberman (1994), values of 80% and above indicate an acceptable level of agreement. Therefore, the result demonstrates a high level of reliability between coders.

Potential bias was minimized through several strategies. Field notes were recorded immediately after sessions to reduce recall bias, and triangulation was achieved by comparing these notes with student feedback. Reflexive consideration of the researcher's dual role as both instructor and investigator was also explicitly acknowledged, ensuring transparency in positionality. These measures align with established qualitative methodologies that emphasize systematicity, credibility, and replicability (Krippendorff, 2004; Miles & Huberman, 1994; Schreier, 2012).

### *3.6. Research Procedures*

The research process was structured in accordance with the five phases of the ADDIE instructional design model and enriched with activities based on the 5E learning model. Within the scope of the study, each phase of the ADDIE model was systematically applied: in the Analysis phase, instructional needs and learner characteristics were identified; in the Design phase, lesson objectives, strategies, and assessment methods were planned; in the Development phase, instructional materials and digital resources were prepared; in the Implementation phase, the lesson plans were applied in the classroom setting; and in the Evaluation phase, both formative and summative assessments were conducted to determine effectiveness and refine the instructional design.

**Analysis:** At the initial stage of the process, an analysis was conducted to identify the lack of Turkish-language resources related to Blender 3D software and to assess students' digital competencies. This analysis also constituted the first evaluation cycle, providing data on content gaps and technical challenges that informed the restructuring of the instructional design. Previous studies on flipped classroom strategies and online learning have shown that this approach helps students come to class better prepared and allows for more efficient use of in-class time (Çepni, 2012). Moreover, it has been noted to offer a more inclusive learning environment for students with diverse learning styles (Lage et al., 2000). Based on this theoretical

framework, a needs analysis was conducted in this study to examine students' online learning experiences and their technical infrastructure.

**Design:** In the design phase, learning objectives and outcome definitions were structured according to the stages of the 5E learning model, and online pre-lesson presentations as well as face-to-face modeling workshops were planned (Bybee et al., 2006; Bishop & Verleger, 2013). Throughout the design process, expert feedback was supported by weekly content evaluations, reinforcing Morrison's (2015) assertion that assessment should be regarded not merely as an outcome but as an integral part of the design itself. During the development stage, feedback was obtained from two academic experts—one in art education and the other in instructional design—and revisions to the lesson plans were made accordingly. In particular, based on expert recommendations suggesting that presenting certain content online would enhance learning efficiency, the video materials were restructured. As a result, a total of 13 videos aligned with the 5E model were made publicly available via YouTube and used as a core component of the flipped classroom strategy. Videos are integrated into the lesson plan as an intervention component within the flipped classroom approach.

**Development:** In the development phase, the sequence of activities, density of visual materials, and learning objectives were re-evaluated based on expert feedback, with particular emphasis on prioritizing content that supports students' spatial thinking skills (Dick et al., 2015). In the second stage of development, video modules were created in alignment with each phase of the 5E learning model. Short introductory videos presenting the Blender 3D interface were designed for the "Engage" and "Explore" phases; hands-on modeling demonstrations were developed for the "Explain" and "Elaborate" phases; and content focused on analyzing student products was prepared for the "Evaluate" phase. These materials were structured for use in both synchronous and asynchronous learning environments, aiming to provide a flexible learning experience that allows students to progress at their own pace (Branch, 2009; van Gumster, 2020). The developed content offers a unique example of how Blender 3D's technical capabilities can be integrated with pedagogical goals to effectively utilize digital tools in visual arts education.

**Implementation:** During the implementation phase, an eight-week pilot study was carried out with students. Each week, the instructional process began with online video lessons prepared by the researcher, followed by face-to-face sessions that included hands-on modeling activities using Blender 3D. Observational data collected throughout the implementation functioned as real-time assessment measures, allowing the instructional design to be continuously adapted in a dynamic and evidence-based manner, in line with the recommendations of Morrison (2015).

**Evaluation:** In the final phase of the study, findings from the implementation process were examined in accordance with the evaluation stage of the ADDIE instructional design model, and the lesson plans developed based on the 5E learning model were revised one last time. The cyclical and iterative nature of the ADDIE model allows instructional materials to be revisited at the end of the implementation process, offering a structure that supports continuous improvement—a feature widely emphasized in the literature (Dick et al., 2015; Branch, 2009). In this context, the revisions made based on implementation data not only enhanced the achievement of pedagogical goals but also contributed to the development of a sustainable instructional model for the effective use of digital tools in education. The final evaluation was not limited to analyzing outcomes; rather, it was approached as a synthesis of assessments conducted throughout each phase of the process. Thus, the ADDIE model was applied not as a linear sequence but as a dynamic and cyclical framework.

Through the integrated use of the ADDIE and 5E models, a holistic structure was established that addressed both pedagogical and instructional design dimensions. A similar study conducted by Vijayakumar et al. (2023) also demonstrated that combining the ADDIE model with learning models can enhance student achievement. Table 1 below presents the structure of the research process according to the ADDIE model, along with weekly content summaries of the 5E-based lesson plans.

Table 1. Lesson Plan Development Steps Aligned with the 5E Model Within the ADDIE Framework

| ADDIE Phase    | Implementation in the Study                                                                                                                                                                                                                                                 | Corresponding 5E Phase |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Analysis       | A literature review was conducted to identify the lack of Turkish-language resources and user experiences related to Blender 3D. A needs analysis was also performed to assess students' digital competencies and their requirements regarding flipped classroom strategies | Engage & Explore       |
| Design         | Learning objectives and outcome definitions were formulated based on the 5E model template (Bybee et al., 2006). Instructional activities were designed to include online pre-lesson presentations and face-to-face modeling workshops.                                     | Explain & Elaborate    |
| Development    | Expert consultations were conducted with two specialists—one in art education and one in instructional design—to gather feedback on the lesson plans. Educational materials were produced in the form of video modules aligned with the full 5E learning cycle.             | Entire 5E Cycle        |
| Implementation | A pilot program was carried out over eight weeks with 15 students. Weekly video lessons were delivered online, followed by in-class 3D modeling activities and reinforcement tasks.                                                                                         | Entire 5E Cycle        |
| Evaluation     | Based on the findings from the implementation phase, the 5E-based lesson plans were revised for the final time.                                                                                                                                                             | Evaluate               |

Based on the feedback and observations gathered during the implementation process, the lesson plans were revised for the final time, and the instructional design was finalized. Each weekly lesson plan was structured in alignment with the phases of the 5E instructional model and supported by flipped learning scenarios that integrated both online and face-to-face activities. Table 2 below presents the weekly content summaries of the lesson plans used during the implementation phase.

Table 2. Weekly Lesson Plans and Content Summaries Structured According to the 5E Learning Model

| Lesson Plan                                                               | Content                                                                                                                                                   |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>5E Lesson Plan 1</b> Blender 3D Installation and Interface Exploration | Students download and install Blender 3D software and explore its interface components. Familiarity with the digital modeling environment is established. |
| <b>5E Lesson Plan 2</b> Object Movements and Coordinate System            | Object movements are practiced along the X, Y, and Z axes. Foundational skills related to spatial awareness and coordinate systems are developed.         |
| <b>5E Lesson Plan 3</b> Adding Objects in Object Mode                     | Basic geometric shapes are added to the scene. The function of Object Mode and scene organization processes are introduced.                               |
| <b>5E Lesson Plan 4</b> Switching Between Modes and Using Edit Mode       | Transitions between Object and Edit Modes are practiced. Basic editing operations are applied.                                                            |
| <b>5E Lesson Plan 5</b> Creating Volume with the Extrude Command          | Surface extension is performed using the Extrude command. Students gain experience in volume creation techniques.                                         |
| <b>5E Lesson Plan 6</b> Surface Detailing                                 | Modeling tools for adding new surfaces to existing objects are introduced. Aesthetic and functional details of the model are enhanced.                    |
| <b>5E Lesson Plan 7</b> Shape Creation with the Loop Cut Tool             | New geometric sections are defined and shaped on objects using tools such as Loop Cut.                                                                    |
| <b>5E Lesson Plan 8</b> Final Project – Designing a House Model           | Students design a house model by applying all techniques learned in previous weeks. The process culminates in a comprehensive application.                |

The finalized version of the lesson plans produced as part of the study is presented in the Appendix. The sample plan included in the Appendix was designed for the GRF4206 Graphic Arts course. The plan, written in Turkish, focuses on the learning domain of 3D modeling and aims to teach the “Edit Mode” features of Blender 3D software. The lesson was structured in accordance with the flipped classroom strategy: students acquired preliminary knowledge through online video content prior to class and reinforced this knowledge through hands-on activities during in-class sessions.

The lesson plan was structured in alignment with each phase of the 5E instructional model:

- In the Engage phase, students were introduced to Blender 3D modes through video content designed to help them connect prior knowledge with new concepts (20 minutes).
- During the Explore phase, students practiced transitions between modes and engaged in visualization activities (20 minutes).
- In the Explain phase, the fundamental features of Edit Mode were presented, and students applied the knowledge acquired from online videos in classroom-based activities (25 minutes).
- The Elaborate phase involved a “Staircase” modeling task, which integrated previously learned techniques into a cohesive application (30 minutes).
- In the Evaluate phase, students’ work was rendered and saved, marking the completion of the instructional sequence (5 minutes).

Three core activities were implemented within the scope of the lesson plan:

- Blender 3D Modes Activity – Students examined the visual effects of Wireframe, Solid, Material Preview, and Render modes.
- Surfaces, Edges, and Vertices Activity – Object manipulation was performed in Edit Mode using Vertex, Edge, and Face selections.
- Staircase Activity – Students designed an original staircase model by applying previously learned techniques, including object duplication, axis-based movement, and slope adjustment.

This sample plan provides a concrete example of how the flipped classroom strategy can be integrated with the 5E instructional model, offering an instructional design that supports both the development of technical skills and the principles of constructivist learning.

### *3.7. Flipped Learning Environment and Digital Material Integration*

To provide further clarity on the operational aspects of the study, the specific details regarding the instructional materials are outlined here. As part of the flipped classroom strategy integrated into the ADDIE framework, a total of 13 instructional videos were prepared by the researcher. Each video lasted between 7 and 15 minutes and was uploaded to YouTube as publicly accessible resources at least one week prior to the corresponding lesson. The video links were shared with student groups, ensuring that learners could access the materials before class. Viewing activity was monitored through group-shared links and YouTube analytics, which provided data on student engagement. The videos introduced the Blender 3D software, focusing on its interface and fundamental tools, and were designed to provide students with preliminary knowledge before engaging in hands-on classroom activities. This procedure supported the “Engage” and “Explore” phases of the 5E learning model and was aligned with the 'Design' and 'Implementation' stages of the ADDIE instructional design process.

### *3.8. Ethical Principles and Permissions*

This study was reviewed for ethical compliance by the Ethics Committee of the Faculty of Science and Engineering at Balıkesir University and was approved with the decision dated 16.01.2025 and numbered E-19928322-108.01-472786. In addition, implementation permission was obtained from the Faculty of Fine Arts, where the study was conducted. Participants were informed about the purpose of the research, participation was based on voluntary consent, and data were collected in accordance with principles of confidentiality.

## **4. Findings and Discussions**

This section presents the impact of the 5E learning model and the flipped classroom strategy—implemented in hybrid modeling courses using Blender 3D—on student experiences, based on qualitative data obtained from teacher field notes. The data collected through field notes taken after each lesson during the eight-

week pilot implementation were analyzed using content analysis; based on recurring expressions, contextual patterns, and pedagogical reflections, the following themes were identified: challenges in use, impact of the learning method, instructional design model, and learning outcomes and development.

Under each theme, students' technical skills, motivation for digital production, adaptation to learning strategies, and responses to the instructional design are presented with supporting observational examples. These themes offer a holistic analysis of observations related to students' learning processes and reveal how the 5E learning model and the flipped classroom strategy are reflected in students' cognitive, technical, and affective dimensions within a hybrid instructional environment. In the following subsections, the findings related to each theme are examined in detail based on categories and codes, and thematic patterns are supported by direct observations derived from field notes. In this way, the pedagogical, technical, and cognitive dimensions of students' experiences in the Blender 3D environment are comprehensively presented. Each theme in this section is addressed sequentially, along with its corresponding categories and codes.

#### 4.1. Difficulties in Use

As a result of the analysis of the field notes recorded by the researcher after each weekly session, the categories and codes presented in Table 3 were identified.

Table 3. Categories and Codes Related to the Theme of Difficulties in Use

| Categories                     | Codes                                                                                                                                                                                                                                                                                                       |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Individual differences         | <ul style="list-style-type: none"> <li>• Lack of familiarity with the Blender 3D interface</li> <li>• Proficiency in keyboard-mouse combinations</li> </ul>                                                                                                                                                 |
| Cognitive difficulties         | <ul style="list-style-type: none"> <li>• Complex features</li> <li>• Multitasking for commands in the interface</li> <li>• Difficulties in task distribution during group work</li> </ul>                                                                                                                   |
| Hardware-related difficulties  | <ul style="list-style-type: none"> <li>• Hardware deficiencies (mouse, keyboard, personal computer, etc.)</li> <li>• Version differences in Blender 3D</li> <li>• Inadequate physical classroom conditions (e.g., limited board visibility, dim lighting, architectural layout of the classroom)</li> </ul> |
| Blender 3D software challenges | <ul style="list-style-type: none"> <li>• Understanding structures within Blender modes (e.g., edit, object, vertex, texture, etc.)</li> <li>• Using tools (e.g., UV unwrapping, knife tool, spin tool, extrude)</li> <li>• Modeling steps using shortcut key combinations</li> </ul>                        |

These findings are consistent with previous studies emphasizing the effectiveness of practice-based and constructivist approaches in digital design education (Cilli-Turner, 2015; Fu et al., 2022; Talan & Gülseçen, 2019). Building on this broader alignment, the detailed analysis of field notes further revealed specific challenges encountered by students during the Blender 3D learning process. As summarized in Table 4, these challenges can be grouped into four categories: individual differences, cognitive difficulties, hardware-related issues, and software-specific obstacles.

Upon examining Table 3, it is evident that students experienced various technical, cognitive, and hardware-related challenges during the learning process involving Blender 3D software.

Individual differences were particularly evident in a lack of familiarity with the Blender 3D interface and the ability to use keyboard and mouse combinations. Students experiencing 3D modeling for the first time had difficulty adapting to these technical details.

Cognitive difficulties emerged in situations that required understanding complex features, responding simultaneously to interface commands, and engaging in multitasking. Additionally, some students were reported to struggle with task distribution and collaboration processes during group work.

Hardware-related difficulties were associated with students' lack of access to essential equipment such as personal computers, mouse, or keyboards. Additionally, differences in Blender 3D versions and the

physical conditions of the classroom environment (e.g., limited board visibility, poor lighting, or architectural layout) negatively affected the learning process.

Challenges related to Blender 3D software were mainly concentrated in understanding the structure of its modes (e.g., edit, object, vertex, texture) and in using specific tools (e.g., UV unwrapping, knife tool, spin tool, extrude). Moreover, executing modeling steps through shortcut key combinations required additional support for some students.

#### 4.2. The Impact of the Learning Method

Table 4 presents the categories and codes related to the learning method, derived from the analysis of field notes.

Table 4. Categories and Codes Related to the Theme of the Impact of the Learning Method

| Categories                   | Codes                                                                                                                                                                                                                                                                                                  |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prior knowledge level        | <ul style="list-style-type: none"> <li>Differences observed in students who watched modeling training videos</li> <li>Game jam experience.</li> <li>Previous experience with similar digital software (e.g., 3D modeling tools like Blender 3D)</li> <li>Advanced digital content creation.</li> </ul> |
| The flipped classroom effect | <ul style="list-style-type: none"> <li>Higher success and faster performance in practical tasks among students who came to class after watching the videos.</li> <li>Decreased need for individual support.</li> </ul>                                                                                 |

As shown in Table 4, students' preparation processes and prior experiences directly influenced their learning pace.

Students with a high level of prior knowledge—particularly those who had watched modeling training videos, participated in events such as game jams, or had experience with similar digital applications—demonstrated faster and more successful performance in practical tasks. Learners with advanced digital content creation experience required less support when completing complex assignments.

The flipped classroom effect revealed that students who came to class after watching the videos progressed more successfully and efficiently in practical activities. This contributed to a reduced need for individual support and enhanced the overall effectiveness of classroom interaction.

#### 4.3. Instructional Design Model

The categories and themes related to the instructional design model are presented in Table 5.

Table 5. Categories and Codes Related to the Theme of the Instructional Design Model

| Categories                       | Codes                                                                                                                                                                                         |
|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Contribution of the 5E model.    | <ul style="list-style-type: none"> <li>Ease of time management.</li> <li>Planned progress</li> <li>Impact of task sequencing.</li> <li>Plan revision through pilot implementation.</li> </ul> |
| Reflections of the ADDIE process | <ul style="list-style-type: none"> <li>Impact of analysis and design on implementation.</li> <li>Plan updates based on observations during the evaluation phase.</li> </ul>                   |

An analysis of the data in Table 5 suggests that the implementation of the 5E learning model and the ADDIE instructional design process enhanced the effectiveness of lesson planning and contributed to a more systematic structure in the instructional process.

The contribution of the 5E model was evident through its positive impact on time management, structured progression, and the sequencing of instructional activities. Observations gathered during the pilot

implementation led to revisions in the lesson plans, which enhanced both the flexibility and effectiveness of the instructional process.

Reflections of the ADDIE process revealed that the analysis and design phases directly contributed to the implementation. During the evaluation phase, observations led to the restructuring of instructional plans. This process supported the cyclical and improvable nature of instructional design.

#### 4.4. Learning Outcomes and Development

Table 6 presents the categories and codes related to the theme of learning outcomes and development.

Table 6. Categories and Codes Related to the Theme of Learning Outcomes and Development

| Categories                    | Codes                                                                                                                                                                                                                        |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Conceptual understanding      | <ul style="list-style-type: none"> <li>• Mastery of the Blender 3D interface</li> <li>• Ability to use modeling tools</li> <li>• Ability to produce advanced models with Blender 3D</li> </ul>                               |
| Digital production motivation | <ul style="list-style-type: none"> <li>• The idea of generating income through 3D modeling</li> <li>• Performing stage design tasks</li> <li>• Development in export-import steps</li> </ul>                                 |
| Process evaluation            | <ul style="list-style-type: none"> <li>• End-of-course repetitions</li> <li>• Question and answer sections</li> <li>• Compensating for deficiencies with video</li> <li>• Decrease in individual support requests</li> </ul> |

At the end of the implementation process, students showed indications of improvement in their conceptual understanding and demonstrated increased motivation toward digital creation.

Conceptual understanding was manifested through students' proficiency in navigating the Blender interface, effective use of modeling tools, and the ability to produce advanced 3D models. Learners began to utilize both the basic and advanced features of the software with greater awareness and intentionality.

Digital production motivation was reinforced by students' growing interest in the idea of generating income through 3D modeling, their successful completion of scene design tasks, and the observable progress in export-import operations.

Findings derived from the analysis of field notes indicated that end-of-lesson reviews, Q&A sessions, and video-supported learning processes enabled students to compensate for their deficiencies. This contributed to a decrease in individual support requests and fostered greater learner autonomy.

In this study, the primary aim was to develop lesson plans based on the 5E instructional model within the scope of Blender 3D-supported hybrid art education, specifically tailored for flipped classroom practices. Accordingly, the findings derived from field notes reflecting the situations encountered during the implementation process played a decisive role in refining and finalizing the lesson plans. The actions taken throughout the process are summarized below.

The instructional design process was notably reinforced by pre-implementation needs analyses and expert consultations. During the needs analysis phase, it was identified that students experienced difficulties in comprehending the Blender 3D interface, that English terminology hindered conceptual learning, and that the lack of Turkish-language resources negatively impacted the learning process. Observations revealed that students struggled to grasp technical concepts, had trouble recalling the functions of modeling tools, and required additional support particularly in shortcut-based operations. Furthermore, expert feedback indicated that students in the visual arts domain were more receptive to practice-oriented examples than to abstract technical explanations. Accordingly, the lesson plans were simplified, conceptual density was reduced, scenario-based learning activities were expanded, and visual material support was strengthened.

The ADDIE model provided a systematic framework for the design of the instructional process; in particular, the analysis and design phases took into account students' prior knowledge, technological

resources, and motivational levels. During the design and development stages, feedback from two experts—one in instructional design and the other in art education—guided the creation of lesson plans aligned with the 5E learning model. Based on expert recommendations, activities aimed at enhancing student engagement were reinforced, especially during the “Explore” and “Elaborate” phases. Additionally, video content was integrated into the lessons through the flipped learning approach. This implementation enabled students to come to class better prepared, progress more efficiently during in-class activities, and reduced the need for individual support. The weekly review of lesson plans was conducted in alignment with the cyclical structure of the 5E model, and content and activities were revised based on ongoing observations.

By the end of the implementation process, a joint evaluation of expert feedback and field notes revealed that the instructional plans had been effectively structured in alignment with both the 5E learning model and the ADDIE design framework. Notably, during the “Evaluate” phase, students demonstrated enhanced self-assessment skills, a significant reduction in modeling time, and improvements in product quality. These outcomes indicate that the design contributed in a balanced manner to cognitive, technical, and affective domains of learning. The flipped video content was perceived by students as a flexible learning tool, which supported motivation and engagement within the hybrid learning environment. It was observed that participants’ ability to access online materials at their own pace and preferred time facilitated the learning process and increased their interest in the course.

Students actively participated in hands-on activities, engaged through trial and error, and peer-sharing processes enhanced their motivation. The 3D modeling outputs demonstrated originality, technical accuracy, and creative aesthetic qualities, indicating that students managed cognitive load and applied conceptual knowledge in practice.

When the data obtained are evaluated holistically, the research findings indicate that the 5E learning model and the flipped teaching strategy increase students' cognitive awareness, optimize their learning speed, and support their productivity in art and design-focused digital learning environments. Observation notes across the eight-week process revealed a gradual development: in the early weeks, students struggled with the Blender 3D interface and required support for basic commands; by the middle of the implementation, they demonstrated faster task completion and greater confidence in tool usage; and in the final weeks, their outputs reflected originality, technical accuracy, and creative aesthetics. Student comments also highlighted increased motivation and self-efficacy as they progressed. Therefore, it can be suggested that designs based on the 5E model and planned through the ADDIE process in hybrid learning environments may support the development of visual arts learners toward becoming more active, independent, and creative individuals.

## 5. Conclusion and Suggestions

In this study, a lesson plan developed based on the 5E teaching model was structured to develop three-dimensional modeling skills in visual arts students. Online and face-to-face activities, supported by a flipped classroom approach, aimed to enhance students' technical proficiency with Blender 3D software and their spatial thinking skills. Data observed throughout the implementation process demonstrated significant improvements in students' learning motivation and software usage skills.

It was observed that students who regularly attended classes and engaged in extracurricular activities approached the lessons with greater enthusiasm and performed more successfully in completing the tasks. Talan and Gülseçen (2019) also emphasize that courses conducted through the flipped classroom model directly influence students’ academic achievement and motivation levels in terms of timing. During the implementation, physical conditions considered as external factors—such as classroom lighting, board visibility, and seating arrangement—were found to negatively affect students’ attention levels. Consequently, it is recommended that the learning environment be reconsidered in terms of lighting, visual accessibility, and ergonomics.

Blender 3D version differences and hardware inadequacies have caused some students to struggle with the application process. Hence, it is recommended that all users have the same version. Blender 3D, the program used, is a dynamic software that receives periodic version updates. As a result, it is recommended

that previously prepared lesson videos be reviewed periodically, and support videos adapted to new versions be created and shared with students. Observational data revealed that some technical content was complex for students. Accordingly, it is recommended that lesson plans be simplified based on the observed data and that the number of application-based activities be increased.

To support the integration of emerging generative artificial intelligence models into the educational process, it is recommended that AI-assisted modeling tools be incorporated into the course content. The use of generative AI tools in the classroom can enhance students' technical skills as well as their creative production processes. Platforms such as Meshy.AI, 3DAI Studio, and Luma Labs Genie, which enable text-to-model conversion, allow students to focus on conceptual design rather than low-level geometry generation. Fu et al. (2022) demonstrated through a systematic review that AI-supported modeling environments improve learning efficiency and increase student satisfaction. Introducing these tools will raise students' awareness of digital design technologies and facilitate their adaptation to industry developments.

In evaluating the research process, it becomes evident that the cognitive learning outcomes observed during the 3D modeling stage were shaped by the interplay of two instructional variables. The flipped classroom method primarily influenced students' motivation and preparedness, as pre-class video engagement allowed them to familiarize themselves with Blender 3D tools and reduced cognitive load during in-class practice. Meanwhile, the 5E lesson plans, structured through the ADDIE framework, provided systematic scaffolding for conceptual understanding, guiding learners through exploration, explanation, and elaboration phases. This dual influence suggests that while flipped learning acted as a motivational and preparatory factor, the 5E and ADDIE design functioned as the cognitive and pedagogical driver. Together, these approaches contributed to the dependent variables of technical skill development, cognitive awareness, and learning motivation, reinforcing the constructivist foundations of digital design education (Bybee, 2006; Bishop & Verleger, 2013; Talan & Gülseçen, 2019).

Finally, based on the findings obtained, it is recommended that the revised 5E lesson plan be re-tested through a new eight-week implementation process. This second iteration will enable comparative analysis with previous pilot results and provide deeper insights into the robustness and effectiveness of the lesson plan. Polanin et al. (2024) demonstrated through meta-analytic findings that repeated implementations of the 5E model lead to cumulative improvements in learning outcomes. Furthermore, adapting the updated plan to different disciplines such as engineering, architecture, and teacher education represents a valuable step toward testing the model's flexibility and broad applicability (Melgarejo et al., 2024). Such interdisciplinary transitions will promote the versatile use of educational technologies and contribute to the dissemination of innovative approaches in instructional design.

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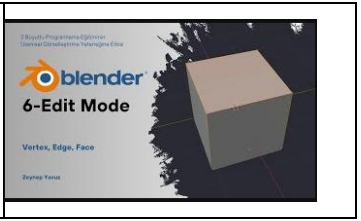
## 7. Appendix

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5E Ders Öğretim Planı 4      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                    |
| Ders                         | GRF4206 Grafik Sanatlar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                    |
| Sınıf Düzeyi                 | GSF bölümü 3. ve 4. sınıf öğrencileri                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                    |
| Öğrenme Alanı                | 3d Modelleme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                    |
| Hedef                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                    |
| Hedef Davranışlar            | 3d modelleme kavramını anlama<br>Blender 3D programı Edit Mode 1                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                    |
| Öğretim Yöntem ve Teknikleri | Gösterip yaptırma ve anlatım tekniği                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                    |
| Öğretim Araç Gereçleri       | Blender 3D yazılımı,<br>Ders içeriği videoları,<br>Ders kayıtları,<br>Bilgisayar.                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                    |
| Sınıf Dışı Aktivite Süre     | 30 dakika                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                    |
| Sınıf İçi Aktivite Süre      | 90 dakika                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                    |
| Dersin İşlenişi:             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                    |
|                              | <b>Sınıf dışı aktivite (Ters yüz edilmiş sınıf)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>Sınıf içi aktivite (Ters yüz edilmiş sınıf)</b>                                                                                                                                                                                                                                                                                                 |
| (Giriş)                      | <b>Çevrimiçi – Eşzamansız (15 dk.)</b><br>Derse gelmeden önce eğitimci tarafından hazırlanan Blender 3D yazılımındaki modların anlatıldığı video öğrencilere iletilerek izlenmeleri sağlanır. Videoda yer alan Blender 3D yazılımındaki görselleştirme için temel adımları oluşturacaktır. Bu video ile öğrenciler şu ana kadar öğrendikleri modelleme becerileri ile görselleştirme öğelerini bağdaştırmak için temel eğitimi alacaklardır.<br><br>Video-1: Blender 3D Eğitimi- 5- Modlar: Wireframe, Solid, Material, Render | <b>Yüz yüze – Eşzamanlı (20 dk.)</b><br>Bir önceki derste işlenen “Annotate”, “Measure” ve “Add-cube” araçlarından hızlıca bahsedilir ardından Blender 3D arayüzündeki görseller hakkında temel bilgi verilir.<br><br>Soru 1: Blender 3D ile oluşturduğumuz nesnelerin görsel özellikleri, renk ve ışıktan etkilenmeleri nasıl ekranda gösterilir? |
| Keşfetme                     | <b>Çevrimiçi – Eşzamansız</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Yüz yüze – Eşzamanlı (20 dk)</b><br>Blender 3D yazılımında mod özellikleri tekrar edilir. Uygulamada dersin videosuna benzeyen bir çalışma yapılır.<br><br>Uygulama 1: Blender 3D modlar                                                                                                                                                        |

|               |                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Açıklama      | <p><b>Çevrimiçi – Eşzamansız (15 dk.)</b></p> <p>Eğitimci tarafından hazırlanan ve youtube üzerinden paylaşılan bir diğer video öğrencilerle paylaşılır. Bu videoda “Edit Mode” özelliklerinin giriş özelliklerine değinilmektedir. Öğrenciler bu videoyu izleyerek derste kısayol tuşlarını öğrenerek gelecektir.</p> <p>Video-1: Blender 3D Eğitimi- 6- Edit Mode : Vertex, Edge, Face Seçimleri</p> | <p><b>Yüz yüze – Eşzamanlı (25 dk.)</b></p> <p>Ders videosunda gösterilen Blender 3D yazılımına ait bir diğer özellik olan “Edit Mode” kısmı anlatılır. Bu dersten sonra özel bir nesne üretmek, nesneleri manipüle edebilmek için artık “Edit Mode” kullanılacağı açıklanır. “Yüzeyler, kenarlar ve köşeler” uygulaması yapılır. Uygulama yapılırken öğrencilerin çevrimiçi paylaşılan videoda yer alan kısayol tuşlarına hakim olduğu göz önünde bulundurularak örnek model oluşturulur.</p> <p>Soru 2: Blender 3D yazılımı kullanarak daha özgün çalışmaları nasıl yapabiliriz?</p> <p>Soru 3: Blender 3D yazılımında Object Mode dışında hangi modlar bulunuyor ve bu modlar ne işe yarıyor?</p> <p>Uygulama 2: Yüzeyler, kenarlar ve köşeler</p> |
| Derinleştirme | <p><b>Çevrimiçi – Eşzamansız</b></p>                                                                                                                                                                                                                                                                                                                                                                   | <p><b>Yüz yüze – Eşzamanlı (30 dk.)</b></p> <p>Ders boyunca anlatılan her iki konunun da birleştirilmesi ile oluşturulacak temel bir nesne yapımı tamamlanmalıdır. “Merdiven” uygulaması yapılır. Değerlendirme kısmına geçilir.</p> <p>Uygulama 3: Merdiven</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Değerlendirme | <p><b>Çevrimiçi – Eşzamansız</b></p>                                                                                                                                                                                                                                                                                                                                                                   | <p><b>Yüz yüze – Eşzamanlı (5 dk)</b></p> <p>Ders kaydı videosu öğrencilerle paylaşılır ve öğrencilerin yaptıkları çalışmaların render fotoğrafları kaydedilerek ters tamamlanır.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

## Videolar

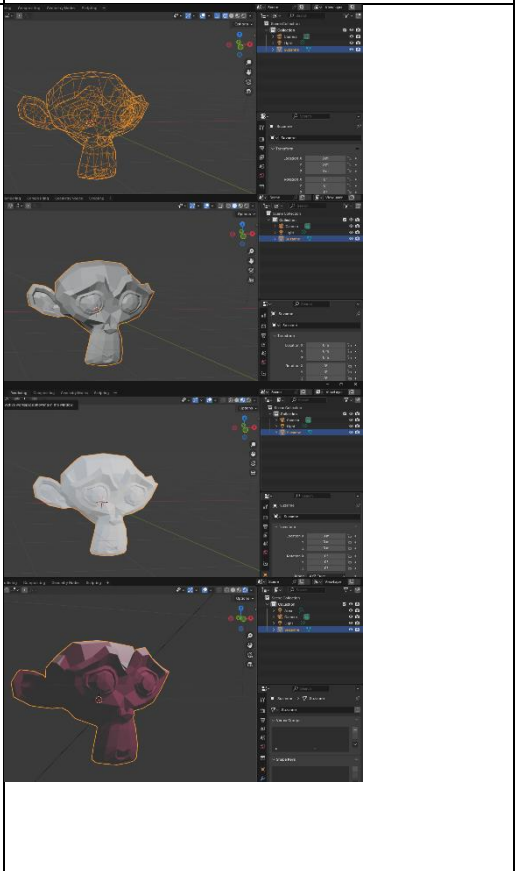
|         | Açıklama                                                                                                                       | Youtube video linki                                                                                             | Görsel                                                                                                                                                                                                             |
|---------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Video-1 | Eğitmen tarafından ders için özel olarak hazırlanan Youtube platformunda bulunan video linki aşağıdaki tabloda yer almaktadır. | <a href="https://youtu.be/oj1ZMNSR_q0?si=CCHbPYStrmQ2KSUB">https://youtu.be/oj1ZMNSR_q0?si=CCHbPYStrmQ2KSUB</a> |  <p>Blender 5-Modlar görseli. Sol tarafta Blender logo ve '5-Modlar' yazısı. Sağ tarafta bir 3D modelin render görüntüsü.</p> |

|                |                                                                                                                                |                                                                                                                 |                                                                                     |
|----------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Video-2</b> | Eğitmen tarafından ders için özel olarak hazırlanan Youtube platformunda bulunan video linki aşağıdaki tabloda yer almaktadır. | <a href="https://youtu.be/d1q-OuBJdi4?si=7NzEC6qd2sO7piDL">https://youtu.be/d1q-OuBJdi4?si=7NzEC6qd2sO7piDL</a> |  |
|----------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|

## Uygulamalar

### Uygulama-1 Blender 3D modlar

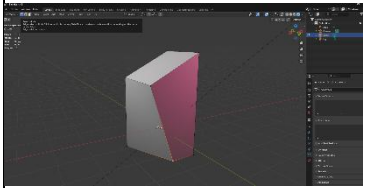
Blender 3D yazılımı arayüzünde bir nesnenin görünümünün ayarlandığı modların uygulanma adımları aşağıdaki tabloda yer almaktadır.

| Blender 3D modlar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Görsel                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Blender 3D yazılımı açılır.</li> <li>2. Arayüzdeki “General” butonuna tıklanır.</li> <li>3. Sahnenin merkezinde yer alan “cube” nesnesi seçilir.</li> <li>4. “Delete” tuşuna basılır ve silinir.</li> <li>5. Sahnenin sol üstünde yer alan “Add” panelinden sırası ile “Mesh&gt;Monkey” seçilir ve sahnenin merkezine “Suzanne” nesnesi çağrılır.</li> <li>6. Arayüzün sağ üstünde yer alan modlar paneline geçilir, bu alanın bir diğer ismi “Viewport Shading” olarak adlandırılmaktadır. Sırası ile bütün görünüm seçilir.</li> <li>7. İlk olarak “Wireframe” seçilir, nesnenin içinde bulunan kenarlar görünür hale gelir. Sağ tarafta en üstte bulunan görseldeki görüntüye erişilir.</li> <li>8. Ardından bir diğer görünüm olan “Solid” seçilir, görsellerde 2. Sıradaki ekran görüntüsündeki gibi görünmektedir.</li> <li>9. Bir sonraki görünüm nesneye doku ve özel eklenen materyalleri bize gösteren görüntü “Material Preview” 3. Sırada yer almaktadır.</li> <li>10. Son olarak model tamamlanınca nesnenin ışık ve sahnede bulunan diğer öğelerden etkilendiği görsel formu olan “Rendered” modu 4. Sırada yer almaktadır.</li> <li>11. Bütün seçenekler tamamlanınca kısaca bu alandaki önemli detayların aktarılmasının ardından uygulama tamamlanır.</li> </ol> |  |

### Uygulama-2 Yüzeyler, kenarlar ve köşeler

Blender 3D yazılımı arayüzünde sahnedeki bir nesnenin yüzey, kenar ve köşelerinin düzenlenmesini sağlayan “Edit Mode” giriş uygulamasının adımları aşağıdaki tabloda yer almaktadır.

|                                          |        |
|------------------------------------------|--------|
| Blender 3D Yüzeyler, kenarlar ve köşeler | Görsel |
|------------------------------------------|--------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Sahnede yeni bir “Cube” nesnesi eklenilir.</li> <li>2. Blender 3D yazılımının arayüzünde, ekranın sol üstünde yer alan “Object Mode” seçimi değiştirilerek “Edit Mode” düzenleme alanına geçilir.</li> <li>3. Bu alana geçmenin kısa yol tuşu “tab” a basılarak her iki mod arasında hızlı geçiş tapılabileceği aktarılır.</li> <li>4. “Select Box” aracı ile nesnenin üzerine gelinip herhangi bir yere tıklanılır. Artık Nesnenin her bir köşesinin ayrı bir şekilde seçildiği gözlemlenir.</li> <li>5. Ardından sahnenin sol üstünde bulunan “Vertex” , “Edge” ve “Face” modlarının her biri ile seçimlerin değiştirilebileceği anlatılır.</li> <li>6. Önce “Face” seçim ile “cube” nesnesinin en üstünde bulunan yüzey seçilir ve “z” ekseninde 2 birim yukarıya hareket ettirilir. Yüzey seçiminin kısayol tuşu olan “3” e basılarak da seçim yapılabileceği öğrencilere ifade edilir.</li> <li>7. Ardından “Edge” seçimi ile üst yüzeyde bulunan kenarlardan birisi seçilerek bu sefer de “z” ekseninde ters yönde 1 birim hareket etmesi sağlanır. Kenar seçiminin kısayol tuşu olan “2” e basılarak da seçim yapılabileceği öğrencilere ifade edilir.</li> <li>8. Son olarak “Vertex” seçimi ile nesnenin alt yüzünde bulunan bir köşe seçilir ve x ekseninde 1 birim hareket etmesi sağlanır. Köşe seçiminin kısayol tuşu olan “1” e basılarak da seçim yapılabileceği öğrencilere ifade edilir.</li> <li>9. Uygulama sonucunda oluşan görsel tablonun sağında yer almaktadır.</li> </ol> |  |
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### Uygulama-3 Merdiven

Blender 3D sahnesinde Edit mode ekranındaki “Select Mode” özellikleriyle yapılan merdiven etkinliğinin adımları aşağıdaki tabloda yer almaktadır.

| Blender 3D Merdiven                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Görsel                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Blender 3D yazılımında sahnenin merkezinde yer alan “Cube” nesnesi seçilir ve “tab” tuşuna basılarak “Edit mode” kısmına geçilir.</li> <li>2. Önce “3” tuşuna basılarak “Face Selection” ile yüzey seçimi aktif edilir.</li> <li>3. Ardından “A” tuşuna bir kez basılır ve ardından “S” tuşuna basılıp 0.2 sayısı yazılarak “Enter” a basılır. Bu işlem ile “Cube” nesnesi 0.2 oranında değişikliği sağlanır.</li> <li>4. Tekrar “A” tuşuna basılır, ardından “G” ve sonra “Y” tuşuna basılarak 2 birim hareket ettirilir.</li> <li>5. Hareket tamamlanınca “A” tuşu ile bütün yüzeyler seçilir, ardından “Shift + D” tuşu ile nesne çoğaltılır, hiçbir tıklama yapılmadan önce “Y” ye ardından “-4” yazılarak kopyalanan nesnenin konumu belirlenir.</li> <li>6. Cube nesnesinin içinde iki adet küçük küp nesnesi bulunmaktadır. Her iki küpün üst yüzeyleri seçilmeli ve “Z” ekseninde yükseklik verilmelidir.</li> <li>7. Bunun için önce küplerden birisinin üst yüzeyi seçilir, ardından diğer küpün üst yüzeyi “Shift” tuşuna basılı tutulup seçilir.</li> <li>8. Her iki yüzey de seçildikten sonra “G” tuşuna, ardından “Z” tuşuna basılıp 10 birim uzatılması sağlanır.</li> </ol> |  |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <ol style="list-style-type: none"> <li>9. Merdiveni tamamlamak için basamakları oluşturma adımına geçilir ve “Edit Mode” içinde sahneye bir “Cube nesnesi daha eklenir. Eklenen nesnenin boyutunu ayarlamak için “S” tuşuna basılıp 0.2 sayısı yazılarak “Enter” a basılır.</li> <li>10. Küçültülen küp, sola taşımak için “G”, “Y”, -2 tuşlarına sırasıyla basılır.</li> <li>11. Basamakları oluşturmak için karşı taraftaki direğe bakan yüzey seçilir ve sırasıyla “G”, “Y”, 4 tuşlarına basılır.</li> <li>12. En altta yer alan basamağı seçmek için imleç ile üstüne gelinip “L” tuşuna basılması gerekmektedir. Ardından “G”, “Z”, 0.5 tuşlarına sırası ile basılır.</li> <li>13. Basamakları çoğaltmak için; “Shift +D” tuşuna basılır ve başka bir yere tıklama yapılmadan “Z” 2 tuşlarına basılır.</li> <li>14. Bir üstte yer alan basamak yine “L” ile seçilir ve “Shift +D” tuşu ile çoğaltılıp “Z” 2 tuşlarıyla merdiven oluşturulmaya devam edilir.</li> <li>15. Toplamda 5 basamak oluşturulunca merdiven tamamlanır.</li> <li>16. “Tab” tuşuna basılarak “Object Mode” geçiş yapılır.</li> <li>17. Nesnenin boyunu ayarlamak için “Cube” seçilir ve “S” tuşuna basılarak istenilen miktarda (0.3) ölçümü değiştirilir.</li> <li>18. Son olarak ardışık bir şekilde “R”, “Y”, -45 tuşlarına basılarak merdivene eğim verilir.</li> <li>19. Nesne tamamlanmış olur, oluşturulan merdiven görseli tablonun sağında yer almaktadır.</li> </ol> |  |
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